Determine the value of each of the following.

1. 3
2. 4
3. 6
4. 4
5. -6
6. 1/3
7. -3
8. 3
9. 3
10. 2/3
11. -2
12. 1/2
13. 1/4
14. 1/2
15. -2
16. -3
17. -3
18. -3

Solve for the unknown.

1. 4
2. 64
3. 6
4. 216
5. -6
6. 4
7. $\frac{1}{4096}$
8. $\frac{1}{4}$
9. 4
10. -3
11. $\frac{1}{9}$
12. 4
13. 4
14. 81
15. (1/4)
16. 4
17. 4
18. -5

① $\log_2 16 = m$

$(\log 16) \div (\log 2) = 4$

② $\log_8 g = 2$ $\quad 8^2 = g \quad g = 64$

③ $\log_g 216 = 3$ $\quad (g^3)^{\frac{1}{3}} = (216)^{\frac{1}{3}}$

$g = 6$

7) $\log_4 j = -6$ $\quad 4^{-6} = j$

$4^{-6} = \frac{1}{4^6} = \frac{1}{4096} = j$

18) $\log_3\left(\frac{1}{243}\right) = x$

$(\log(\frac{1}{243}))/(\log 3) = -5$

15) $\log_f f = 4$ $\quad f^4 = f$

Rules for Logarithms

1) $\log_b(mn) = \log_b(m) + \log_b(n)$
Multiplication inside the log can be turned into addition outside the log, and vice versa.

2) $\log_b(m/n) = \log_b(m) - \log_b(n)$
Division inside the log can be turned into subtraction outside the log, and vice versa.

3) $\log_b(m^n) = n \cdot \log_b(m)$
An exponent on everything inside a log can be moved out front as a multiplier, and vice versa.

Warning: Just as when you're dealing with exponents, the above rules work only if the bases are the same.

Condensed Simplified		Expanded
$\log_b(mn)$	=	$\log_b(m) + \log_b(n)$
$\log_b(m/n)$	=	$\log_b(m) - \log_b(n)$
$\log_b(m^n)$	=	$n \cdot \log_b(m)$

Expand $\log_3(2x)$

multiplication $m=2$ $n=x$

$\log_3 2 + \log_3 x$

Expand $\log_4(16/x)$

$\log_4 16 - \log_4 x$

Expand $\log_5(x^3)$

$3\log_5 x$

Expand $\log_2(8x^4/5)$

$$\log_2 8x^4 - \log_2 5$$
$$\log_2 8 + \log_2 x^4 - \log_2 5$$
$$\log_2 8 + 4\log_2 x - \log_2 5$$

Simplify $\log_2(x) + \log_2(y)$.

$$\log_2(xy)$$

Simplify $\log_3(4) - \log_3(5)$

$\log_3\left(\frac{4}{5}\right)$

Simplify $2\log_3(x)$

$\log_3 x^2$

Simplify $3\log_2(x) - 4\log_2(x + 3) + \log_2(y)$.

$\log_2 x^3 - \log_2(x+3)^4 + \log_2 y$

$\log_2 x^3 - \log_2(y)(x+3)^4$

$\log_2 \frac{x^3}{(y)(x+3)^4}$